

Functional Plant Biology

Contents

Volume 34 Issue 9 2007

Review: The lutein epoxide cycle in higher plants: its relationships to other xanthophyll cycles and possible functions

Jose I. García-Plazaola, Shizue Matsubara and C. Barry Osmond 759–773

The xanthophyll lutein epoxide (Lx) is being found in increasing numbers of plants, so an examination of its function is timely. This is important review brings together the most recent observations on Lx and the Lx cycles, their possible functions and the distribution of this pathway.

The effect of elevated CO₂, soil and atmospheric water deficit and seasonal phenology on leaf and ecosystem isoprene emission

Emiliano Pegoraro, Mark J. Potosnak, Russell K. Monson, Ana Rey, Greg Barron-Gafford and C. Barry Osmond 774–784

Isoprene plays a key role in atmospheric quality. The effects of atmospheric CO₂ concentration and drought on isoprene emission are of interest in improving our understanding of how forests respond to global change. At Biosphere 2, these effects were investigated in a stand of *Populus deltoides*. Significant interactions were seen, which vary with growth season. The results have important implications for atmospheric chemistry.

Resistance to radial CO₂ diffusion contributes to between-tree variation in CO₂ efflux of *Populus deltoides* stems

Kathy Steppe, An Saveyn, Mary Anne McGuire, Raoul Lemeur and Robert O. Teskey 785–792

CO₂ efflux from stem surfaces is a much more complex process than previously thought, and very few studies have addressed the potential cause of variability. Where this team has previously demonstrated that the source of stem CO₂ efflux to the atmosphere may originate from sites away from the release point, they now show that substantial barriers to CO₂ diffusion exist in clonal poplar stems, and that diurnal shrink and swelling of stems will influence stem CO₂ efflux rates.

Responses to chilling of two *Eucalyptus globulus* clones with contrasting drought resistance

Filipe Costa e Silva, Alla Shvaleva, M. Helena Almeida, M. Manuela Chaves and João S. Pereira 793–802

The hardwood species *E. globulus* is grown widely due to its fast growth and fiber properties, although its distribution is restricted by cold and drought sensitivity. This study compares growth and plant hydraulic responses of drought-resistant and -sensitive clones to chilling stress. The drought-resistant clone responded to low temperature stress with a higher rate of root growth, and had lower transpiration rates and root and leaf hydraulic conductance compared with the drought-sensitive clone.

Simultaneous *in situ* detection of alkaline phosphatase activity and polyphosphate in arbuscules within arbuscular mycorrhizal roots

Rintaro Funamoto, Katsuharu Saito, Hiroshi Oyaizu, Masanori Saito and Toshihiro Aono 803–810

Whilst many terrestrial plants live in symbiosis with arbuscular mycorrhizal fungi, which transfer inorganic phosphate from the soil to the host plant, the metabolism in arbuscules is not well understood. These authors developed a protocol for the simultaneous detection of polyphosphates and fungal alkaline phosphatase activity in roots, and show a correlation between the amount of polyphosphate and detectable ALP activity in arbuscules.

Cover illustration: Lutein epoxide accumulates in shaded inner canopy leaves of *Inga sapindoides* (photo by Cornelia-Büchen Osmond; from the Eden Project, Bodelva, Cornwall, UK) but the Lx cycle in these leaves is only slowly reversible following exposure to strong light (see García-Plazaola *et al.* pp. 759–773).

β -Glucuronidase activity in seedlings of the parasitic angiosperm *Cuscuta pentagona*: developmental impact of the β -glucuronidase inhibitor saccharic acid 1,4-lactone
Mark A. Schoenbeck, Gabriel A. Swanson and Sydney J. Brommer 811–821

This work characterises the occurrence of β -glucuronidase (β -GUS) in germinating seeds and seedlings of the parasitic plant *Cuscuta pentagona*, and examines the effect of saccharide lactone and its potential use in the control of parasitic angiosperm development. The authors employ saccharide lactone as a pharmacological inhibitor to examine the physiological role of β -GUS, and demonstrate its developmentally contingent potency in affecting seedling growth. Their results suggest an important role for β -GUS at the early stages of germination in *C. pentagona*.

Overexpression of sedoheptulose-1,7-bisphosphatase enhances photosynthesis and growth under salt stress in transgenic rice plants
Lingling Feng, Yujun Han, Gai Liu, Baoguang An, Jing Yang, Guohua Yang, Yangsheng Li and Yingguo Zhu 822–834

This research provides insight into a poorly understood mechanism: salt tolerance. The authors show that overexpression of SBPase in transgenic rice increases salt tolerance, correlated with greater capacity to maintain CO₂ assimilation in response to salt stress. This suggests that overexpression of SBPase enhances salt tolerance; where Rubisco activase associates with the thylakoid membrane in salt-treated controls, this is less evident in the SBPase overexpressing lines.

The maize Activator/Dissociation system is functional in hexaploid wheat through successive generations
Gabriela M. Pastori, Alison Huttly, Jevon West, Caroline Sparks, Alejandro Pieters, Celina M. Luna, Huw D. Jones and Christine H. Foyer 835–843

These authors demonstrate the use of the maize Activator/Dissociation (*Ac/Ds*) system to tag genes in hexaploid wheat. Such two-component transposon systems are a useful means to generate insertion mutants. Independent 21 *Ds* and 14 *Ac* lines were developed, and 900 F1 plants generated through 49 independent crosses. Development of this technology in cereal provides a valuable tool for assigning gene function.

Photoinhibition and D1 protein degradation in mesophyll and agranal bundle sheath thylakoids of maize
Berenika Pokorska and Elzbieta Romanowska 844–852

Photoinhibition and D1 protein degradation was measured in thylakoid membranes of mesophyll and bundle sheath chloroplasts of maize, to investigate D1 degradation in thylakoids in response to photoinhibitory high light. The authors showed that the presence of ATP as well as protease inhibitors against thylakoid associated proteases (FtsH and Deg isoforms) delays D1 protein degradation in both mesophyll and bundle sheath thylakoids. They conclude that PSII is indispensable in agranal bundle sheath membranes, despite its low electron transport activity.

Viewpoint: Avoiding common pitfalls of chlorophyll fluorescence analysis under field conditions
Barry A. Logan, William W. Adams III and Barbara Demmig-Adams 853–859

Current understanding of photosynthetic light use owes more to chlorophyll fluorescence analysis than to any other technique. Chlorophyll fluorescence emission helps us assess plant stress responses, but the methodology can be misused, as instrument advancements may lead one to underestimate the complexity involved in collecting interpretable data. This *Viewpoint* helps non-specialist or inexperienced field scientists avoid some of the pitfalls.

Corrigendum to:

Plant isotopic composition provides insight into mechanisms underlying growth stimulation by AM fungi in a semiarid environment

José I. Querejeta, Michael F. Allen, María M. Alguacil and Antonio Roldán [Vol. 34, No. 8 (2007) pp. 683–691] 860